

# System for Electrolysis of Water to Produce Hydrogen

UT-B ID 200902263



## Technology Summary

The electrolysis of water offers an alternative method for large scale production of hydrogen, without toxic and environmentally damaging byproducts. By using multiple microelectrodes on a substrate plus nearby counterelectrodes, an ORNL researcher invented a scalable means of splitting water into hydrogen and/or oxygen. This system functions without ion-conducting material and therefore requires less electrocatalytic precious metal than conventional methods.

Demand for hydrogen gas is increasing, both for industrial applications and for use as a clean fuel source. Conventional methods for producing hydrogen involve the breakdown of fossil fuels, such as coal gasification, and result in the release of large quantities of carbon monoxide and carbon dioxide. Hydrogen production through electrolysis relies on electricity, so it can be powered by renewable energy sources such as solar, hydroelectric, or wind. Conventional electrolysis methods have not yet been competitive for large-scale production, though, due to labor and materials costs.

This new system for electrolysis of water applies an electric voltage across the multiple microscaled catalytic electrodes. The system can be scaled up by increasing the number of microscaled electrodes on a suitable substrate. Hydrogen is produced at the negative electrode (cathode) and oxygen is produced at the positive electrode (anode). In one version of the technology, a patterned substrate can be embedded with multiple microscaled catalytic electrodes. This permits the relevant portion of the electrode to be exposed to water during operation. In addition, the method offers options for lithographic patterning of the microelectrodes onto a substrate and the integration of microelectrical systems (MEDS) devices.

## Advantages

The advanced electrolysis system provides for:

- Low-cost materials
- Scalable production and increased output of oxygen and hydrogen
- Reduced maintenance
- Automated diagnostic analysis and maintenance
- Computerized control of the hydrogen and oxygen generating components

## Potential Applications

- Large-scale hydrogen and oxygen production plants
- Hydrogen source for the energy, semiconductor, chemical, and telecommunication industries

## Patent

Elias Greenbaum. *Apparatus and Method for the Electrolysis of Water*, U.S. Patent Application 12/963,857, filed December 9, 2010.

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